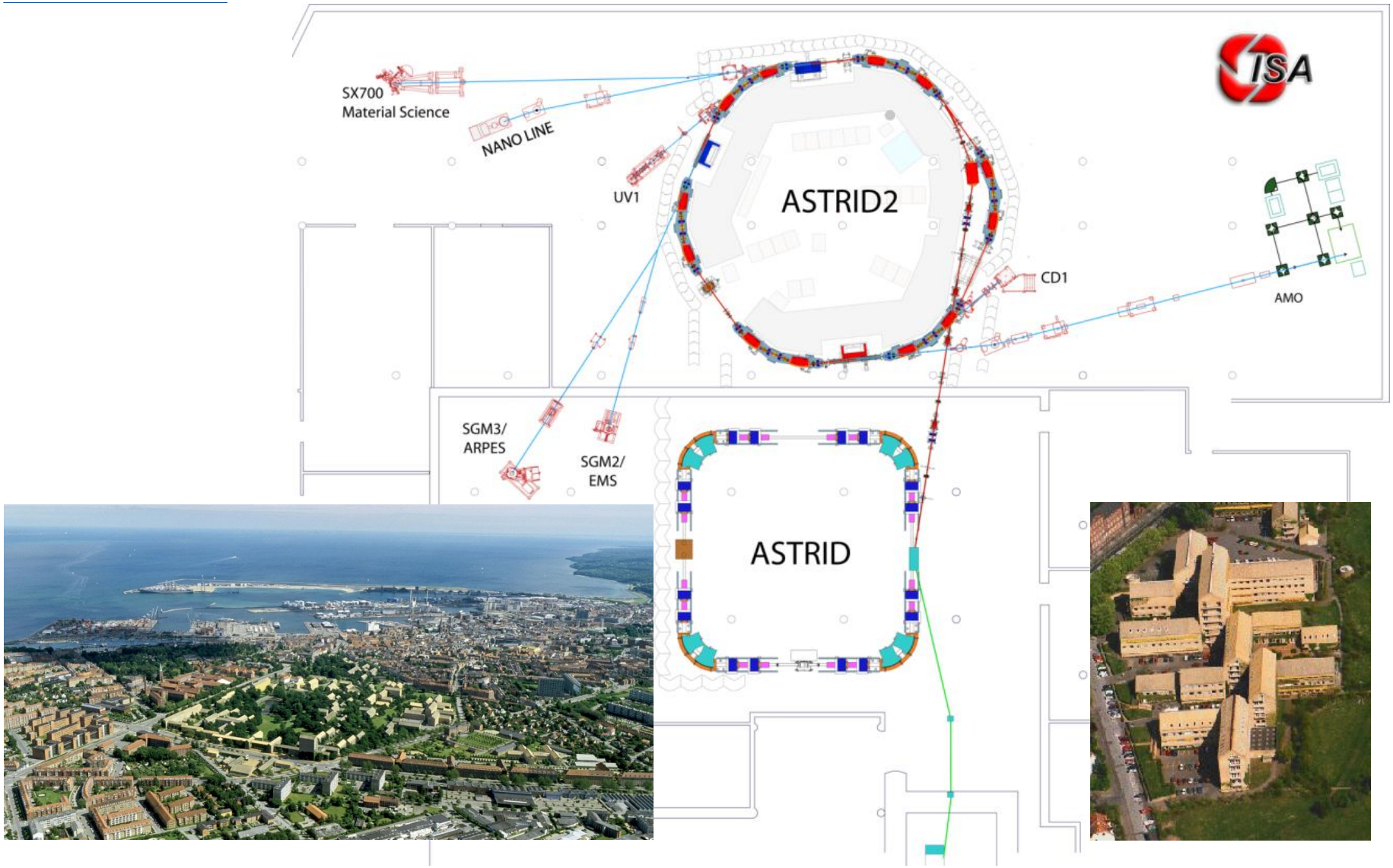
AARHUS
UNIVERSITET

6. DECEMBER 2012

CONSYS UPDATE & A LABVIEW FPGA BASED RF SYSTEM

TORBEN WORM
ISA - DEPARTMENT OF PHYSICS & ASTRONOMY

ASTRID/ASTRID2 OVERVIEW



ASTRID AND ASTRID2

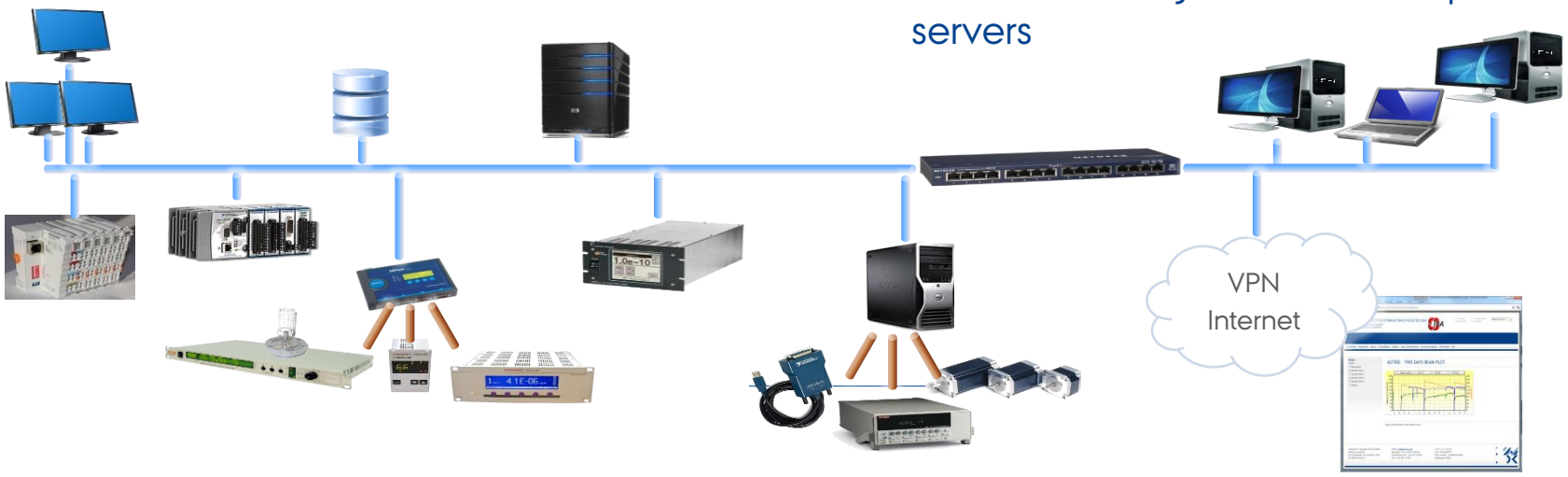
	ASTRID	**ASTRID2**
Energy	580MeV	580MeV
Design current	200mA	200mA
Injection	From 100 MeV microtron once a day	580MeV from ASTRID Top-up every 3-4 minutes.
Emittance	140nm	10nm
Free straight sections	1 (2)	4

CONSYS – THE CONTROL SYSTEM

- Control System for
  - University of Aarhus: ASTRID,ASTRID2, ELISA and several smaller machines
  - Stockholm University: CRYRING, DESIREE
- Mature system, running since 1998
- Standard model, publisher/subscriber
- Running on Windows
- Microsoft C++, object oriented based on MFC classes
- Same core system on all computers
- Configurable – Stored in SQL database
  - Address device and parameter location
  - Conversion information for scaling etc.
  - Display information

CONSYS DEVICES

- Old systems
  - Generic I/O
    - G64
  - Dedicated hardware
    - Serial and GPIB, connected directly to device computer.
- New systems: Ethernet
  - Generic I/O
    - PLC's
    - NI Shared variables
    - EPICS channels
  - Dedicated hardware
    - Preferable Ethernet
    - Serial Communication
      - Serviced through MOXA serial port servers



CONSYS PARAMETERS

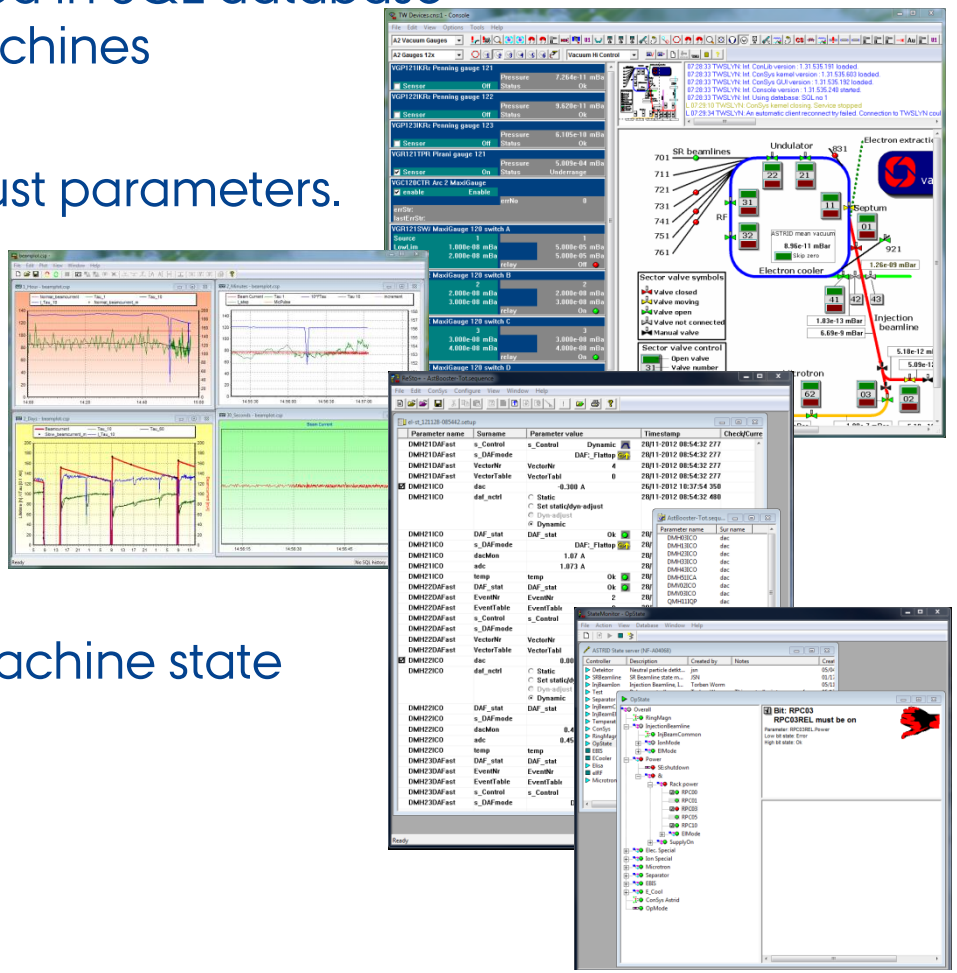
- Basic parameter types:
  - BOOLEAN, WORD, FLOATING POINT, TIME, STRING
- Complex parameter types:
  - Any structure can be a parameter
- Clusters
  - Parameters are grouped into clusters
  - Typical relates to a specific piece of hardware
  - No binding on the source of the parameter, can be from several different devices/locations
- Naming
  - <Cluster name>.<sur name>, ex. BMH100IPSast2.Iw

AUTOMATION

- Strong support for automation
  - Any ConSys device can access any ConSys parameter
  - Used in automation devices
- Examples
  - Electron operation:
    - The steps involved in injections are heavily automated
    - Copying of different settings for store and accumulations
    - Automatic RF power control
    - …
  - Calculation of power & resistance from current & voltage
  - Simultaneous control of several parameters
  - Averaging

GENERAL APPLICATIONS

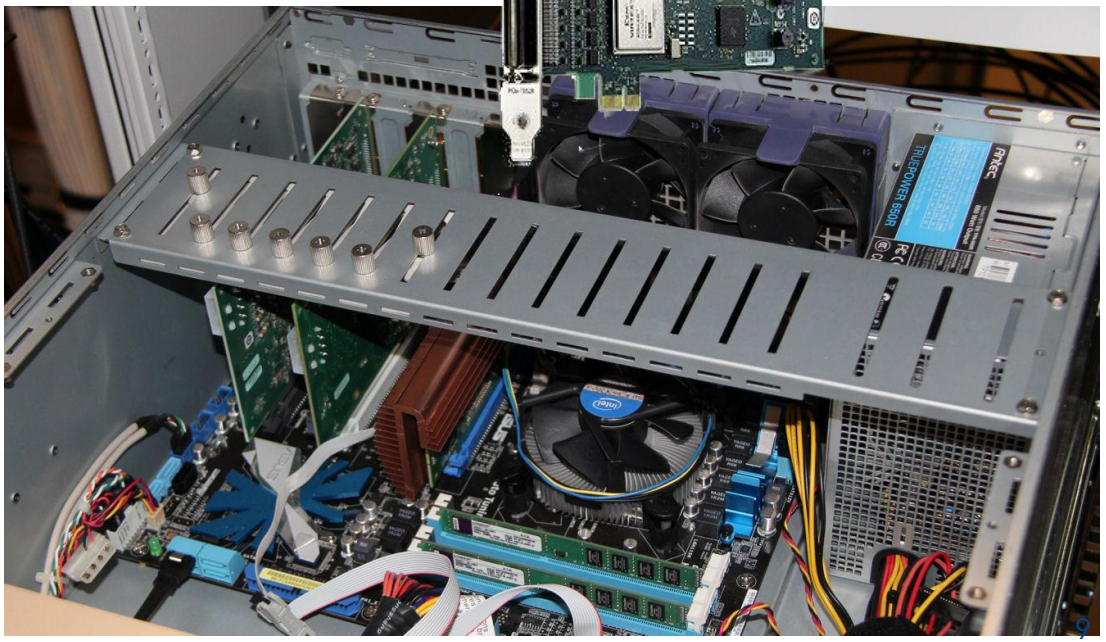
- Machine independent applications
  - Configurable, configurations stored in SQL database
  - Same applications used at all machines
- Console
  - Main program to display and adjust parameters.
- CSPlot
- Datalogger
- ReSto
- RampControl
- StateMonitor
  - Condition based monitoring of machine state
- FileLogger
- MassScan



NEW ASTRIDx LLRF

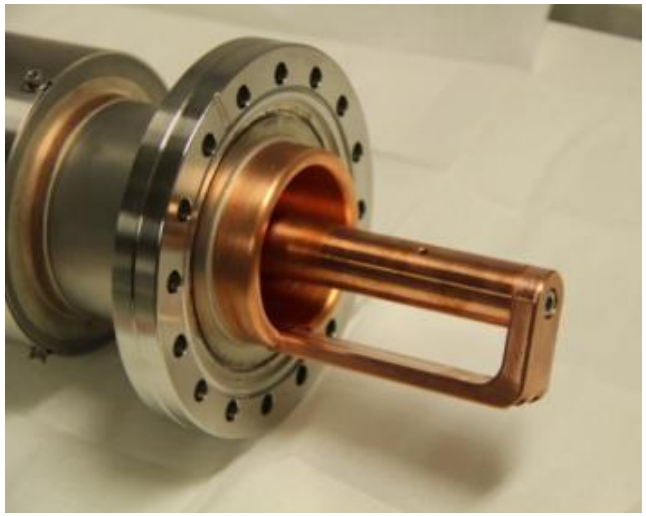
- Since January 2011: New LLRF in operation at ASTRID
- Has been working without any problems
- Same system used for ASTRID2 (except for different tuning control)

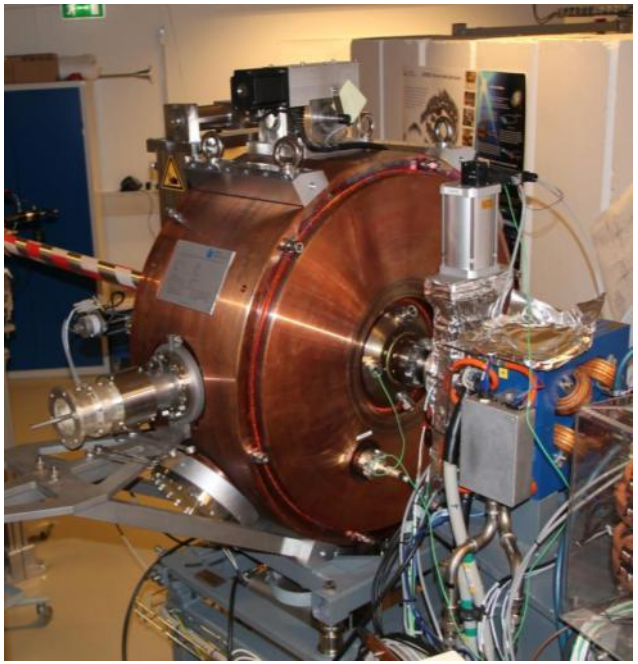
- Rack PC:
  - LabVIEW Real-Time
  - FPGA equipped multifunction card
- NI PCIe-7852R:
  - Virtex 5 FPGA, 8 AI, 750 kS/s/ch, 8 AO, 1 MS/s/ch, 16 bit
- PCIe-6323
  - 16 AI, 250 kS/s/ch, 4 AO, 16 bit



RF CAVITY

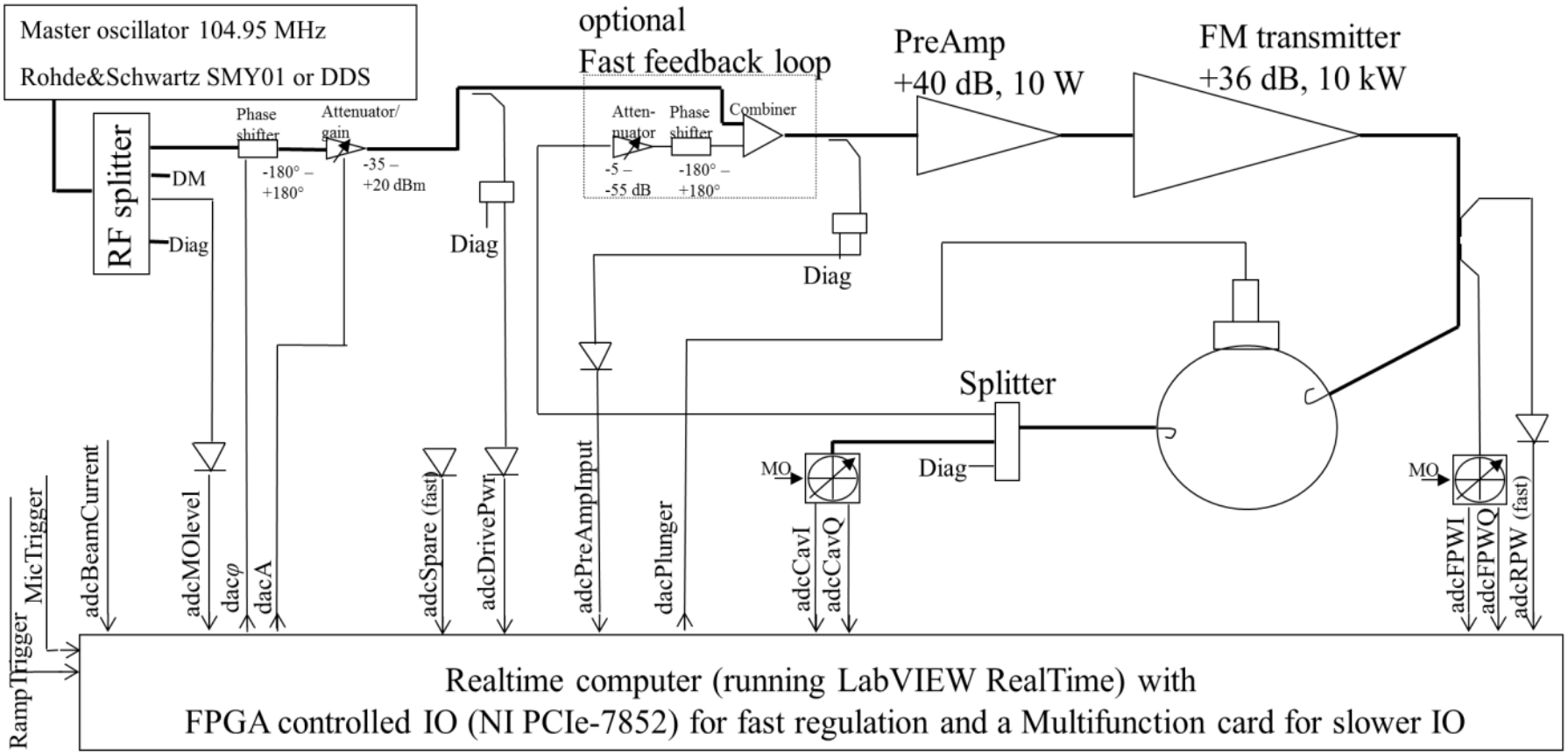
- The 105 MHz cavity (modified MAX IV design) was made by Research Instruments.
- The transmitter is a 8kW solid state unit from Tomco (Australia).





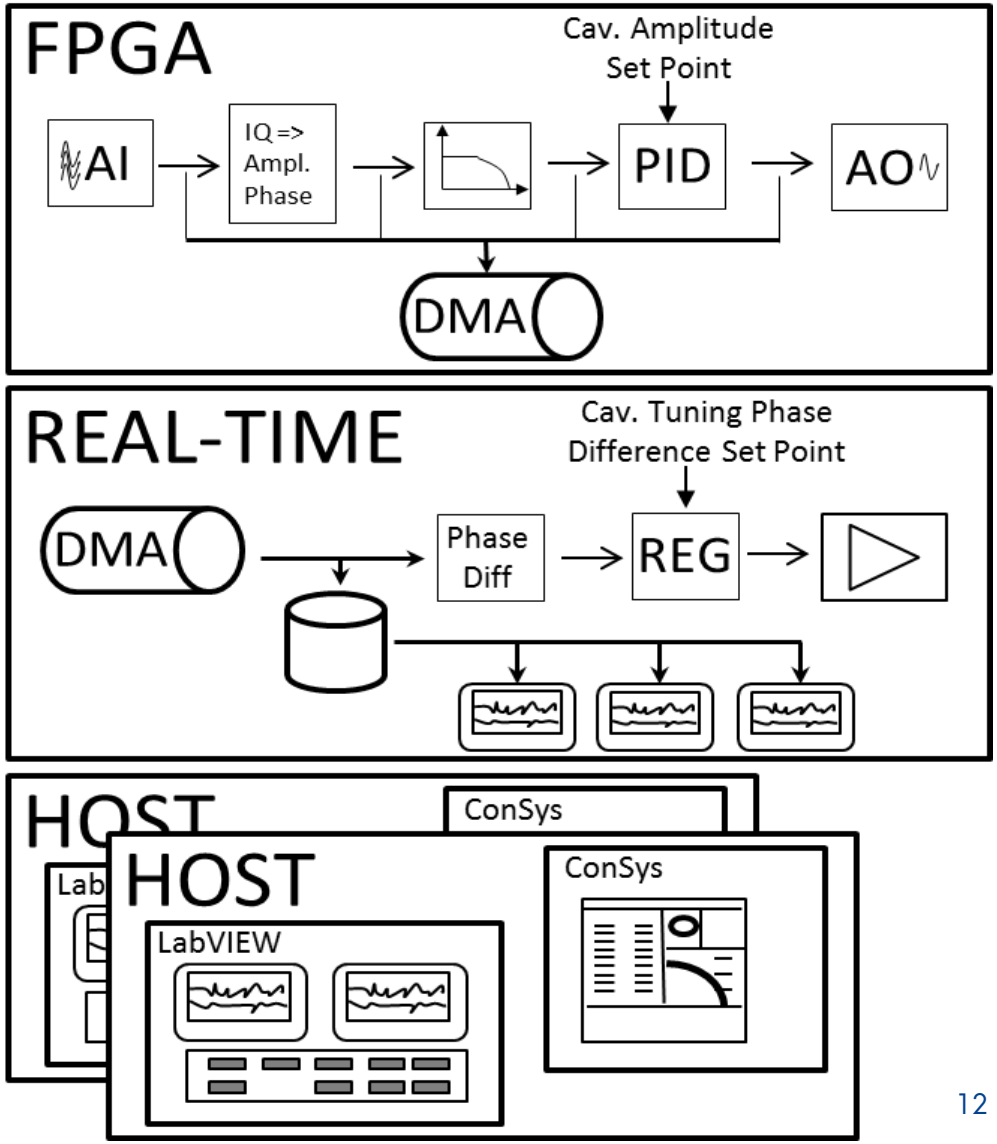
RF SYSTEM – DESIGN LAYOUT

- Digital control of baseband signal
- Detection: IQ demodulators with low pass filter
- ±180 phase detection
- Control: Amplitude and Phase (voltage controlled)



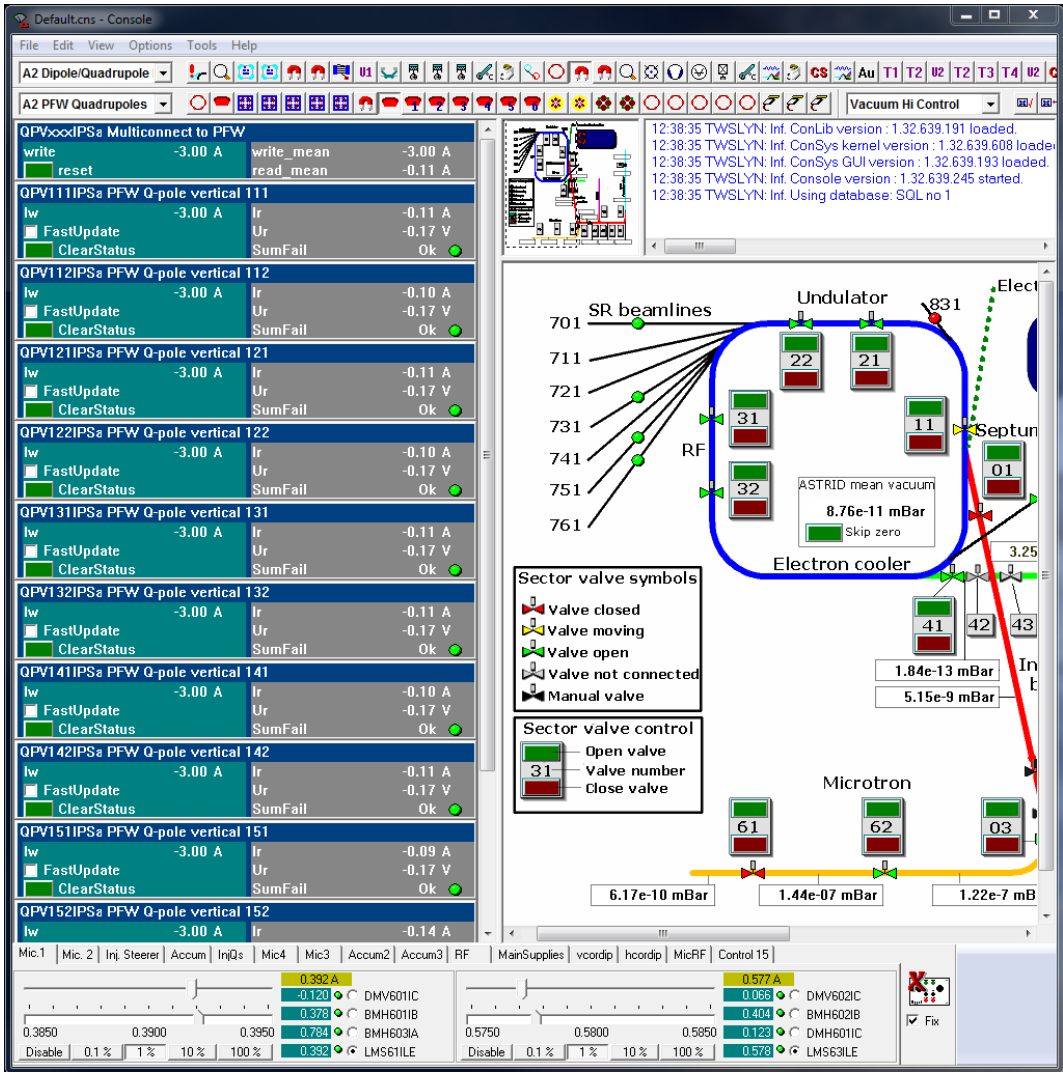
RF SYSTEM SOFTWARE

- FPGA
  - 500 kHz sampling rate
  - Calculate Amplitude & Phase from IQ
  - Low pass filter
  - Amplitude loop, bandwidth ~ 50 kHz
  - DMA: Measured & Calculated values
- Real-Time
  - Cavity tuning loop
  - Phase Loop
  - History buffer
  - Generation of live plots
  - User interface through shared variables
- Host
  - LabVIEW operator display
  - Display live plots generated by RT
  - Control & Status through RT shared variables
- ConSys
  - Control & Status through RT shared variables
- All levels: LabVIEW 2012



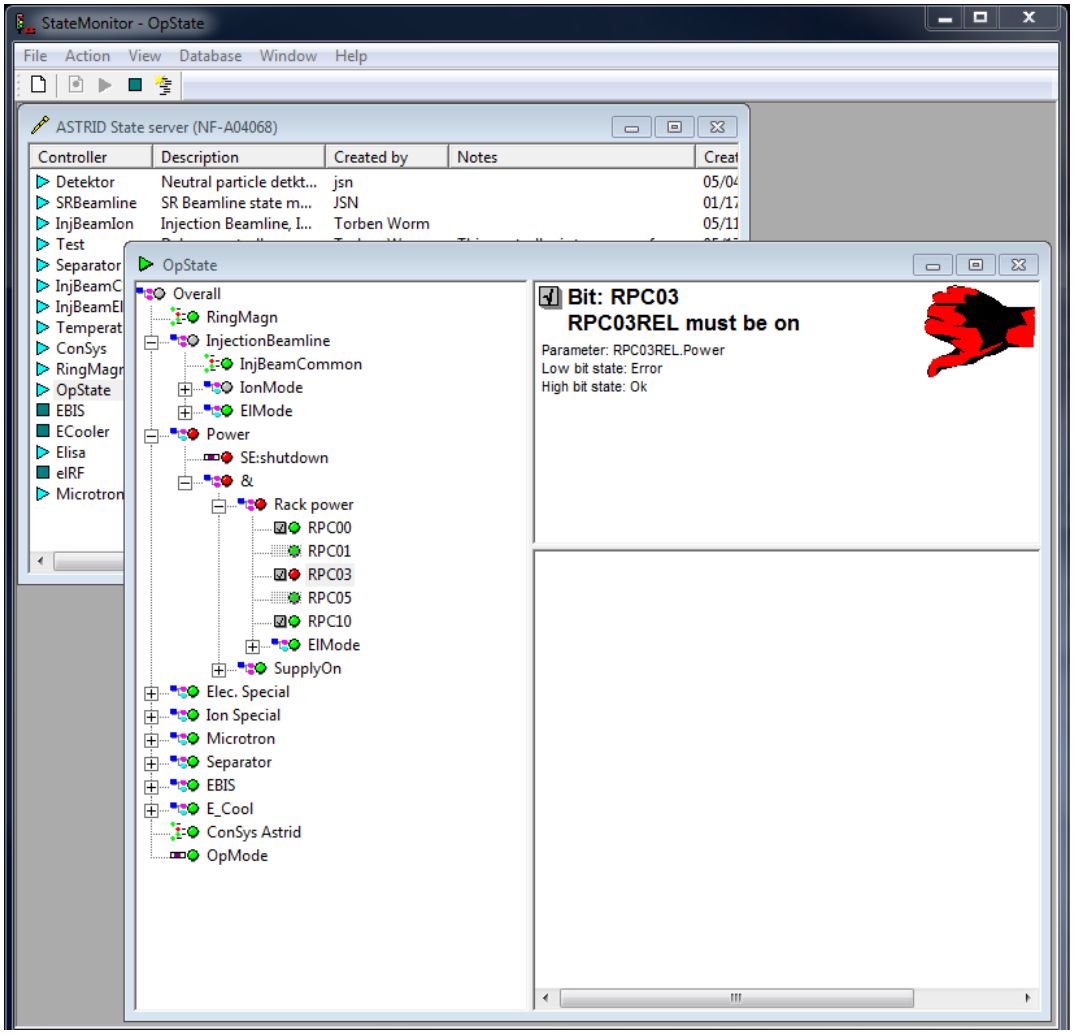
CONSOLE

- Main program to display and adjust parameters.
- Machine independent
  - Console pages defined in database
- 'Analogue' control
  - Control bars with 'analogue' control of two parameters.
  - Mouse control
  - Digital potentiometers
- Graphics pages based on drawings with overlaid controls.



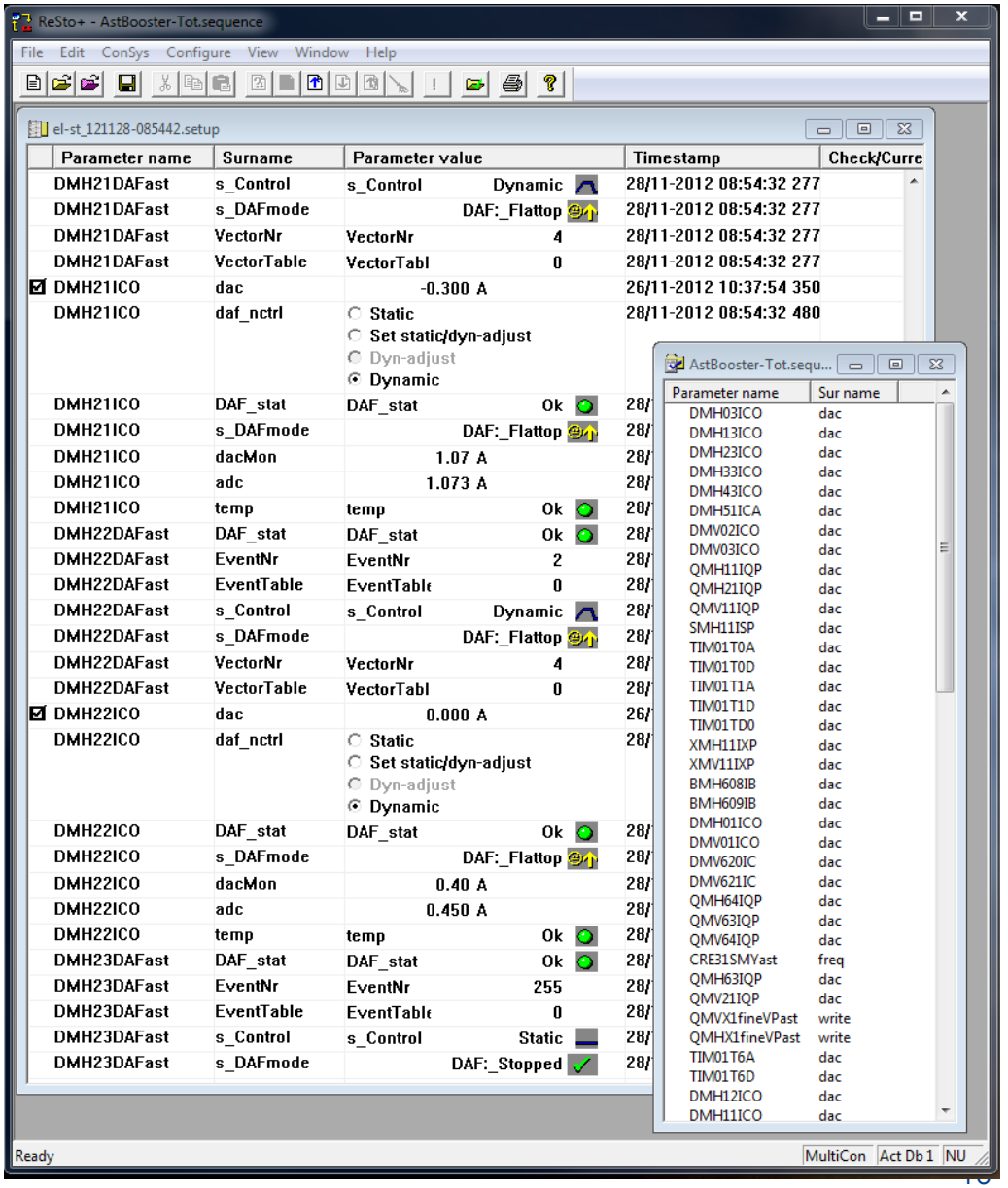
STATEMONITOR

- Machine State Monitoring
  - Condition based
  - Tree structure
  - Leaves:
    - Parameter based conditions
    - Constants
- Tree structure
  - Logical operations
    - Timed override
  - SMS alarms
  - E-mail alarms



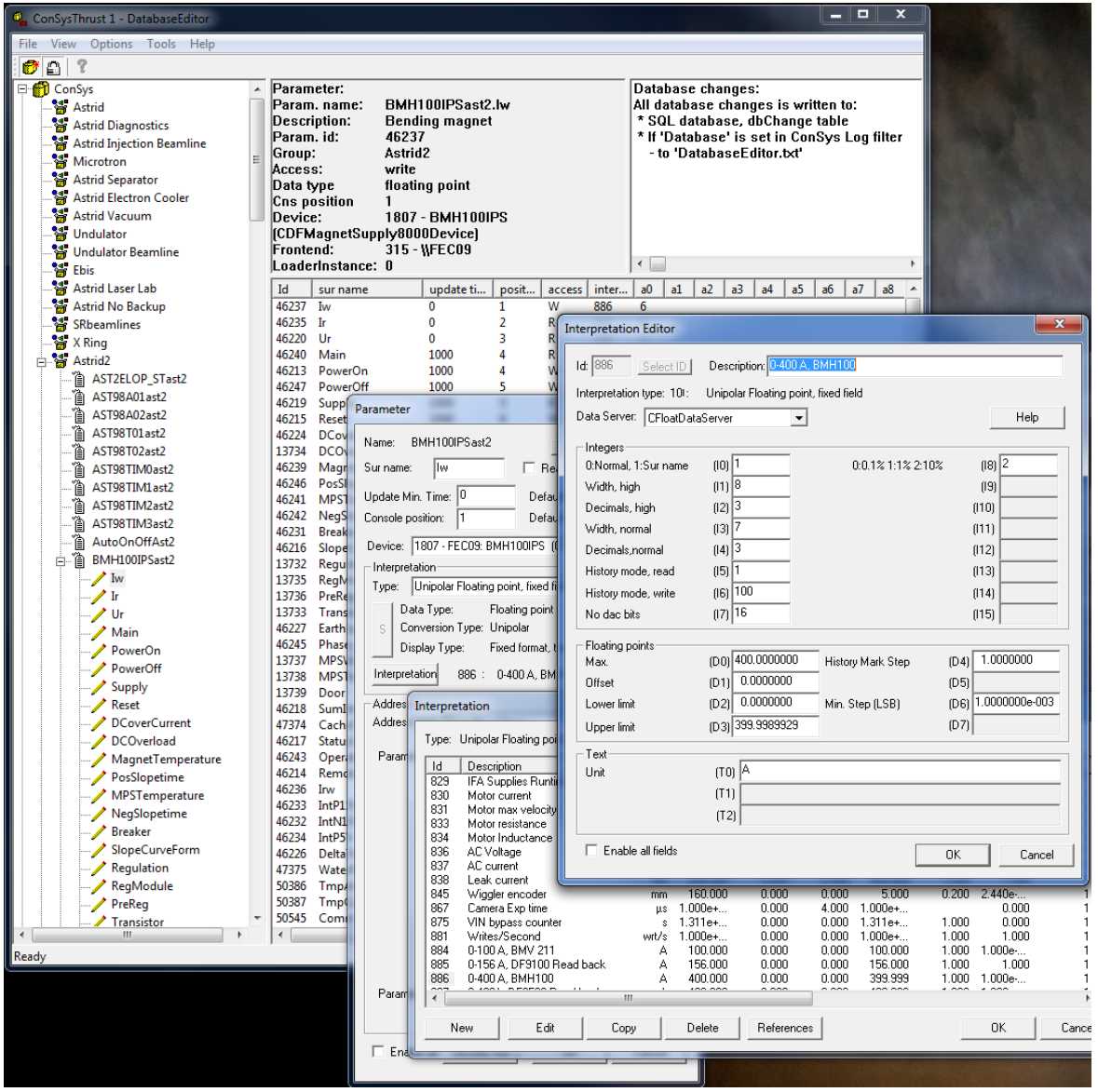
RESTO

- Store
  - All values (in groups)
  - Read/Write
- Restore
  - Selected parameters
  - Based on sequence files
- Compare
  - Current value with stored value
- Periodic
  - Store all
  - Retrieve values from several files



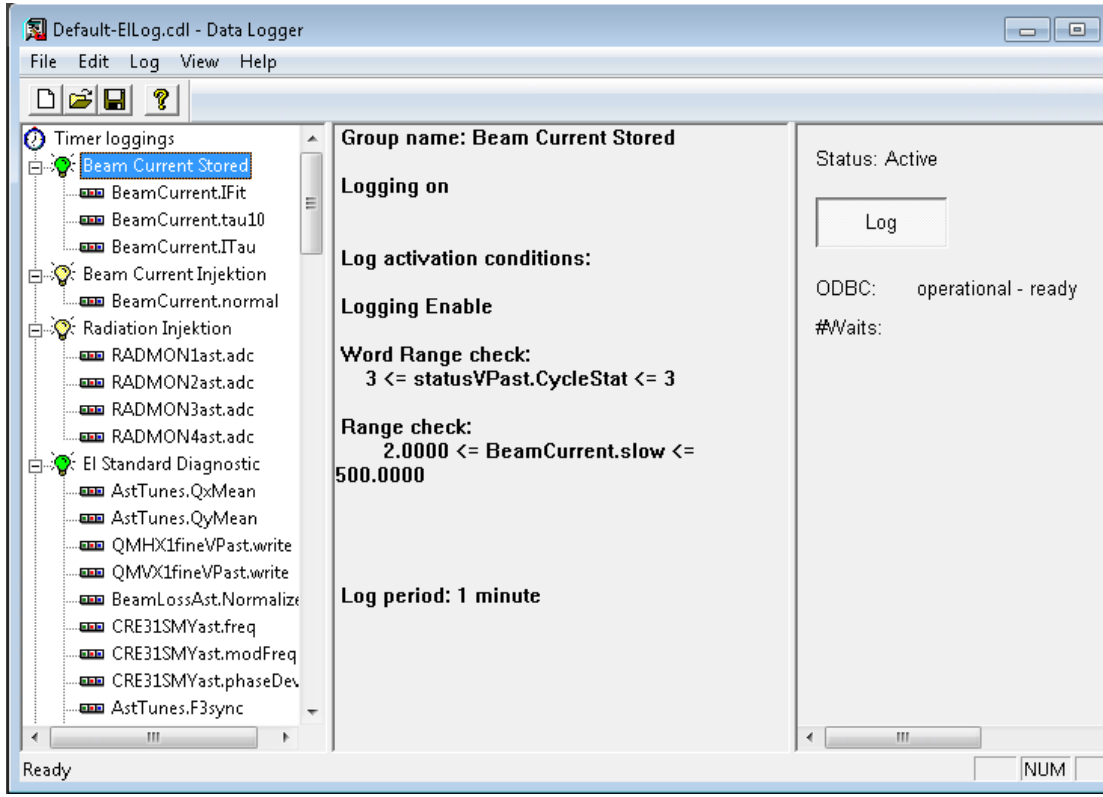
DATABASEEDITOR

- Configuration of ConSys DB
- Tree structure:
  - Machine Groups
    - Clusters
      - Parameters
  - General DB tables
    - Fields like a0..aN
    - Type specific editing
      - Named general fields
      - Only used fields active



DATALOGGER

- Log selected parameters to a SQL database.
- Logging groups
  - Parameters in groups
  - Common log conditions
  - Fixed intervals
- Retrieval
  - Web application
  - CSPlot



CSPLOT

- General plot program
  - Plot any parameter
  - Unlimited #parameters
- Histories
  - From devices at start-up
    - Parameter history stored in RAM by devices.
    - Typically 2 weeks of data stored
  - Longer histories
    - Retrieve SQL data logged by DataLogger